

How to Launch a Networked Improvement Community: Lessons from the *BetterBook* project

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Overview

「01」 The Who

「02」 The What

「03」 The Why

「04」 The Where

「05」 The How

A 5x5 grid of colored squares. The colors of the squares, from top-left to bottom-right, are: purple, blue, green, orange, red; dark purple, dark blue, dark green, dark orange, dark red; purple, blue, green, orange, red; dark purple, dark blue, dark green, dark orange, dark red; purple, blue, green, orange, red. The text "NETWORKED IMPROVEMENT COMMUNITY" is centered in white capital letters over the middle three rows and all five columns.

NETWORKED IMPROVEMENT
COMMUNITY

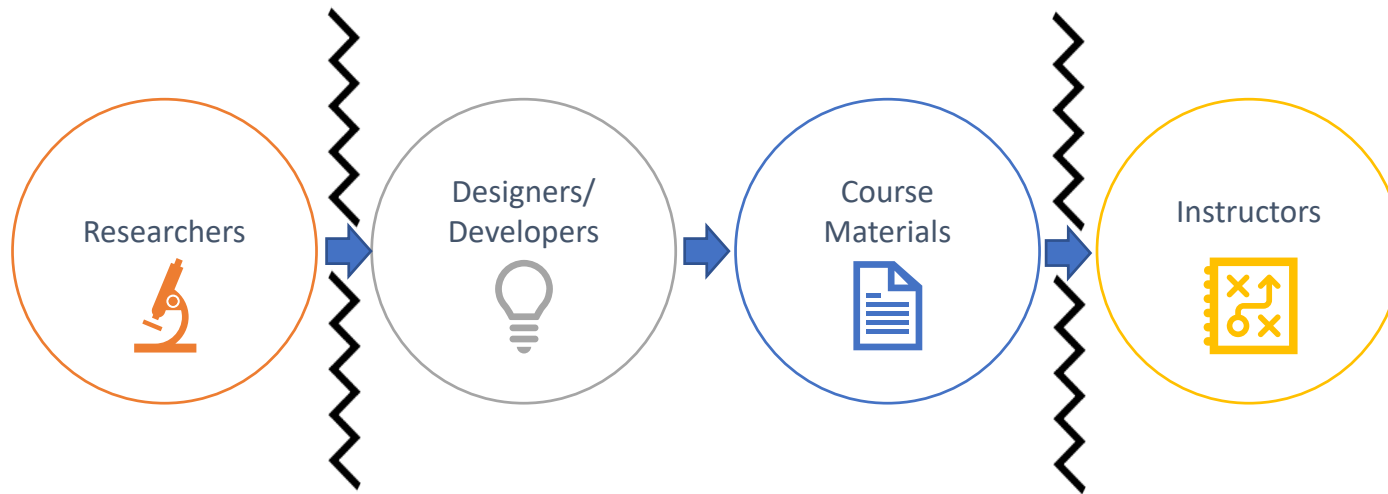


THE WHO

Key Players in the Network



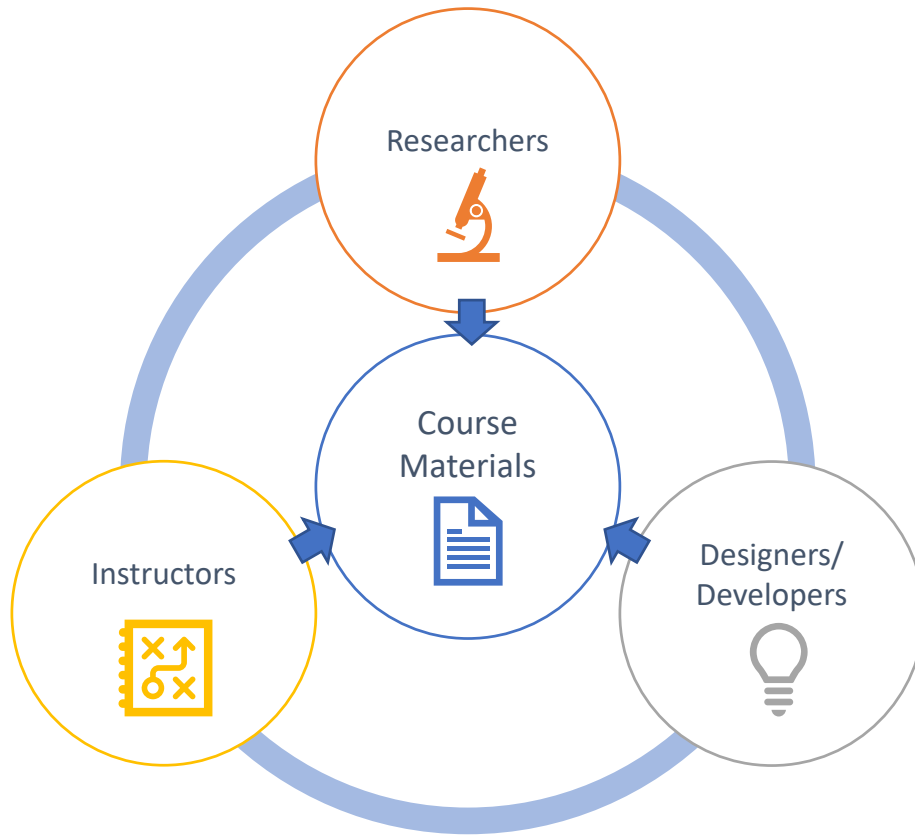
Key Players in Good Instruction



What we're left with:

- Working in silos
- Lack of ecological validity (lab studies, < 1 hour)
- Lack of translational / implementation research
- Persistent gap between research and practice
- Lack of systems focus

Better Book Approach: Vision



Build R&D communities
around development
and continuous
improvement of
high-impact courses

Strategy:
Learn by doing

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THE WHAT

An Object Around Which to Collaborate



Introduction to Statistics: A Modeling Approach

Fully Instrumented Interactive Textbook

“Chapters” with “pages”

Narrative Interleaved with questions, R exercises, video

Sum of squares worked fine as a way to quantify error around the mean, and compare error across two distributions when both distributions had the same sample size. But SS isn't as easily interpreted when sample sizes vary.

The reason for this is that each time you add another data point to the sample distribution, you are adding another squared deviation from the mean to the total SS. So even if two distributions appear to be equally well modeled by their respective means, they may have very different SS. SS always grows as the number of data points in the distribution gets larger, irrespective of the degree of spread.

Can you think of a way to measure error that would not be influenced by sample size? Hint: What could you do to keep SS from growing each time you add another data point?

Copy Cut Paste

0 Word(s)

Learnosity: Ch6_Sum_7

This problem is solved by adding two new statistics to our toolbox: *variance* and *standard deviation*. To calculate variance, we start with the sum of squared deviations from the mean, and then divide by the sample size to end up with a measure of *average error* around the mean—the average of the squared deviations.

Because it is an average, variance is not impacted by sample size, and thus, can be used to compare the amount of error across different sizes.

The formula for variance, usually represented as s^2 , is this:

$$\frac{\sum_{i=1}^n (Y_i - \bar{Y})^2}{n - 1}$$

1200+ formative assessments

Open-ended

R coding

Multiple choice

Try calculating the variance of **Thumb** from the larger **Fingers** data frame.

```
script.R
1 # calculate the variance of Thumb from the Fingers data
  frame
2 var()
```

R Console

Hint

Run

Submit

DataCamp: ch6-5

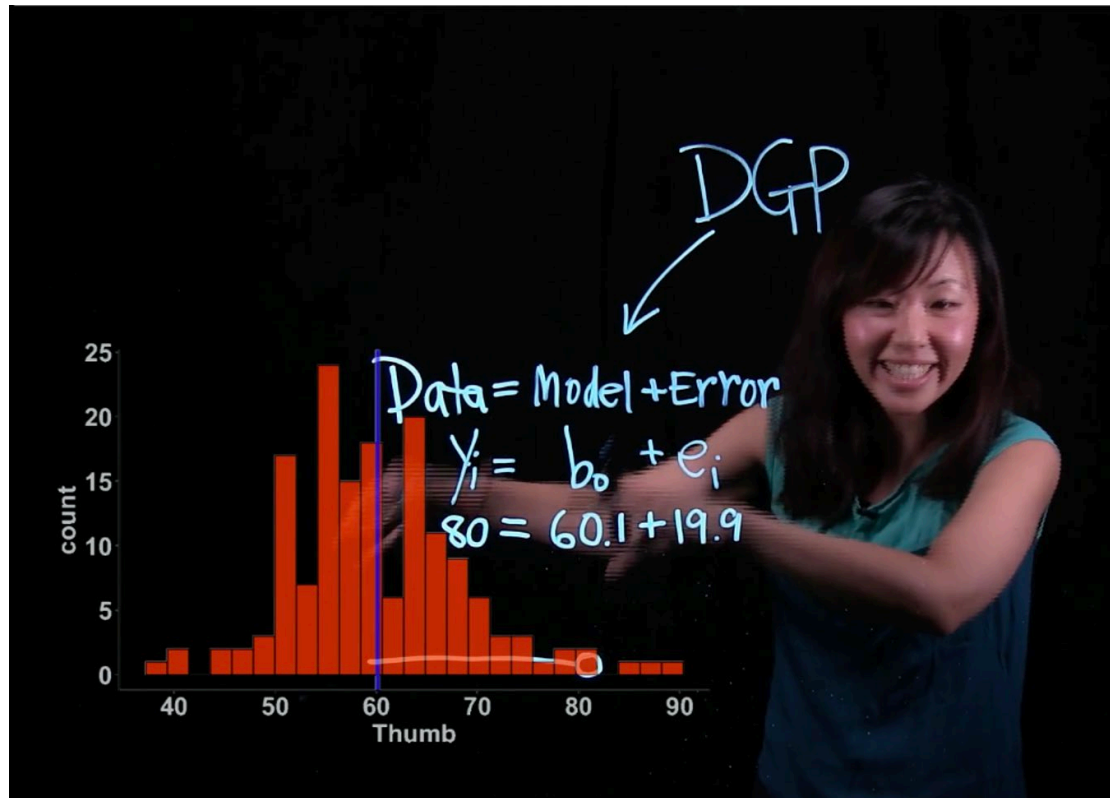
```
## [1] 76.1552
```

What is the correct interpretation of the value 76.1552?

- A There are about 76 thumbs that are larger than the mean.
- B There are about 76 thumbs that are different from the mean.
- C The average squared deviation in this distribution is about 76 squared mm.
- D The average deviation in this distribution is about 76 mm.
- E The average thumb in this distribution is about 76.

Learnosity: Ch6_Sum_10

✓ Submit



All Activities Generate Data

Can you think of a way to measure error that would not be influenced by sample size? Hint: What could you do to keep SS from growing each time you add another data point?

0 Word(s)

253 / 256
attempted


 responses from
all students

Learnosity: Ch6_Sum_7

Responses

QUESTION:

Can you think of a way to measure error that would not be influenced by sample size? Hint: What could you do to keep SS from growing each time you add another data point?

Student	Response
	You can have a limit to how far the data points go? I am unsure.
	Variance and SD.
	You could divide by the sample size to find the standard deviation.
	You would want to get the average.
	We should measure the average error around the mean instead by dividing SS by the sample size.
	By taking the average error. This way, the SS won't grow as much since the added data points would be taken into account (i.e. divided by).

script.R

```

1 # calculate the variance of Thumb from the
  Fingers data frame
2 var()
```

R Console

> |

253 / 256
attempted

86%
correct

Hint

Run

Submit

DataCamp: ch6-5


response	attempts_to_correct
# calculate the variance of Thumb from the Fingers data frame var(TinyFingers\$Thumb)	2
# calculate the variance of Thumb from the Fingers data frame var(Fingers\$Thumb)	1
# calculate the variance of Thumb from the Fingers data frame var(Fingers\$Thumb)	1
# calculate the variance of Thumb from the Fingers data frame var(Fingers\$Thumb)	1
# calculate the variance of Thumb from the Fingers data frame var(Thumb\$Fingers)	2
# calculate the variance of Thumb from the Fingers data frame var(~Thumb,Data=Fingers)	2
# calculate the variance of Thumb from the Fingers data frame var(Fingers\$Thumb)	1
# calculate the variance of Thumb from the Fingers data frame var(~Thumb, data=Fingers)	1

What is the correct interpretation of the value 76.1552?

A	There are about 76 thumbs that are larger than the mean.	1%
B	There are about 76 thumbs that are different from the mean.	2%
C	The average squared deviation in this distribution is about 76 squared mm.	74%
D	The average deviation in this distribution is about 76 mm.	17%
E	The average thumb in this distribution is about 76.	7%

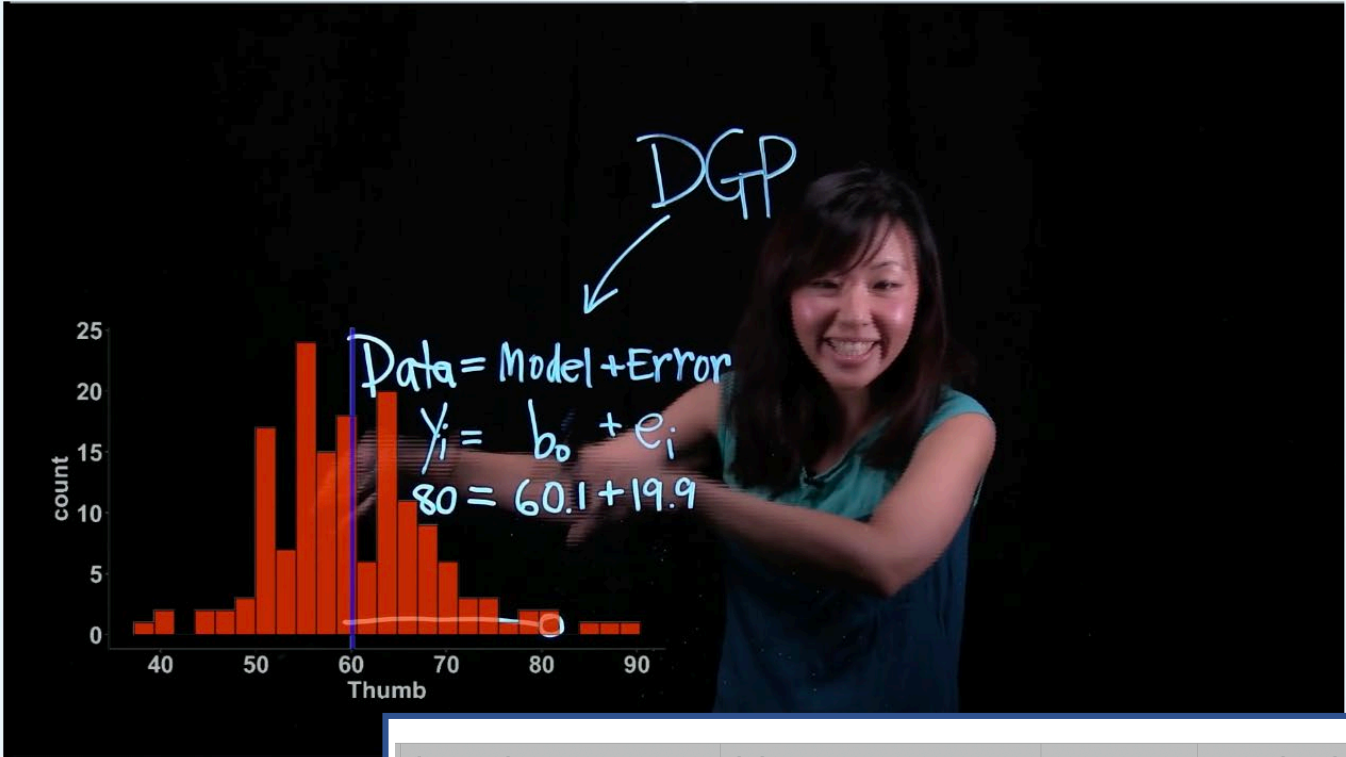
253 / 256
attempted

74%
correct



responses from
all students

Learnosity: Ch6_Sum_10



54 / 256
viewed

69%
average percentage
of the video viewed



information from
all students

dt_started	dt_last_event	access_count	proportion_video	proportion_time
2020-01-23T22:39:38.993+0000	2020-01-31T04:36:09.484+0000	2	1.0	1.982353933028910
2020-01-24T06:14:02.904+0000	2020-01-24T06:19:00.480+0000	1	1.0	1.015842919722100
2020-01-22T18:42:28.826+0000	2020-01-22T18:47:37.916+0000	1	1.0	1.0



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THE WHY

The Need for a NIC



**Started with ambitious goal:
Transferable knowledge of introductory
statistics for all students.**

Understanding the Problem

- Statistic
- Parameter
- Sum of squares
- Variance
- Standard deviation
- T-test
- Correlation
- Regression
- Experiment
- Random assignment
- Random sample
- Null hypothesis
- Alternative hypothesis
- Z-score
- Z distribution
- $p < .05$
- Random variable
- Quartiles
- Interquartile range
- Sampling distribution
- Randomization test
- Confidence interval
- Sampling variation
- Model
- Chi-square
- ANOVA
- Normal distribution
- Margin of error
- F-test
- Paired t-test

**Common
approach:**

**Define small
learning
objectives —
the *bits* —
and teach
them to
mastery.**

Understanding the Problem

- Statistic
- Parameter
- Sum of squares
- $p < .05$
- Random variable
- Quartiles

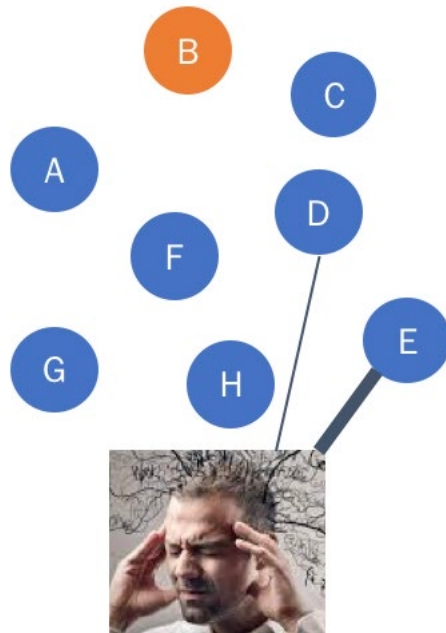
- Variance
- Standard deviation
- T-test
- Correlation
- Regression
- Experimental design
- Random assignment
- Random sampling

Problem:
Students learn the bits, but often don't see the connections, and can't transfer to new contexts.

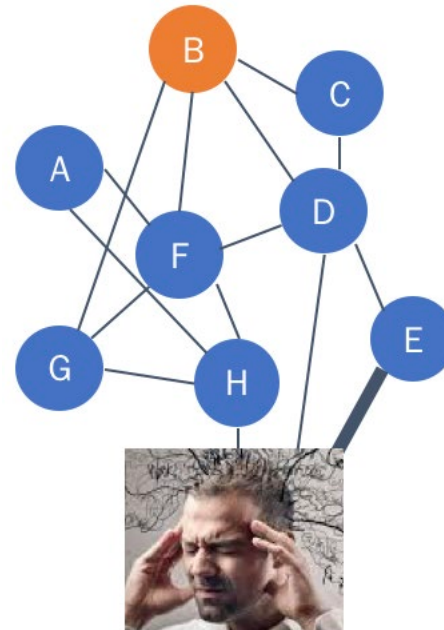
- Null hypothesis
- Alternative hypothesis
- Z-score
- Z distribution
- Normal distribution
- Margin of error
- F-test
- Paired t-test

Connections and Transfer

Few Connections



Many Connections



Goal: activate, represent, coordinate, and flexibly adapt statistical concepts and skills in novel situations

Theories We're Testing

If the goal is transfer, why not practice transfer?

- *Practicing Connections* to create coherent, flexible knowledge:
 - Core Concepts (form coherent structure of the domain)
 - Representations
 - The World

Testing something so new takes multiple perspectives
and a conscious, deliberate process

 That's the "WHY"

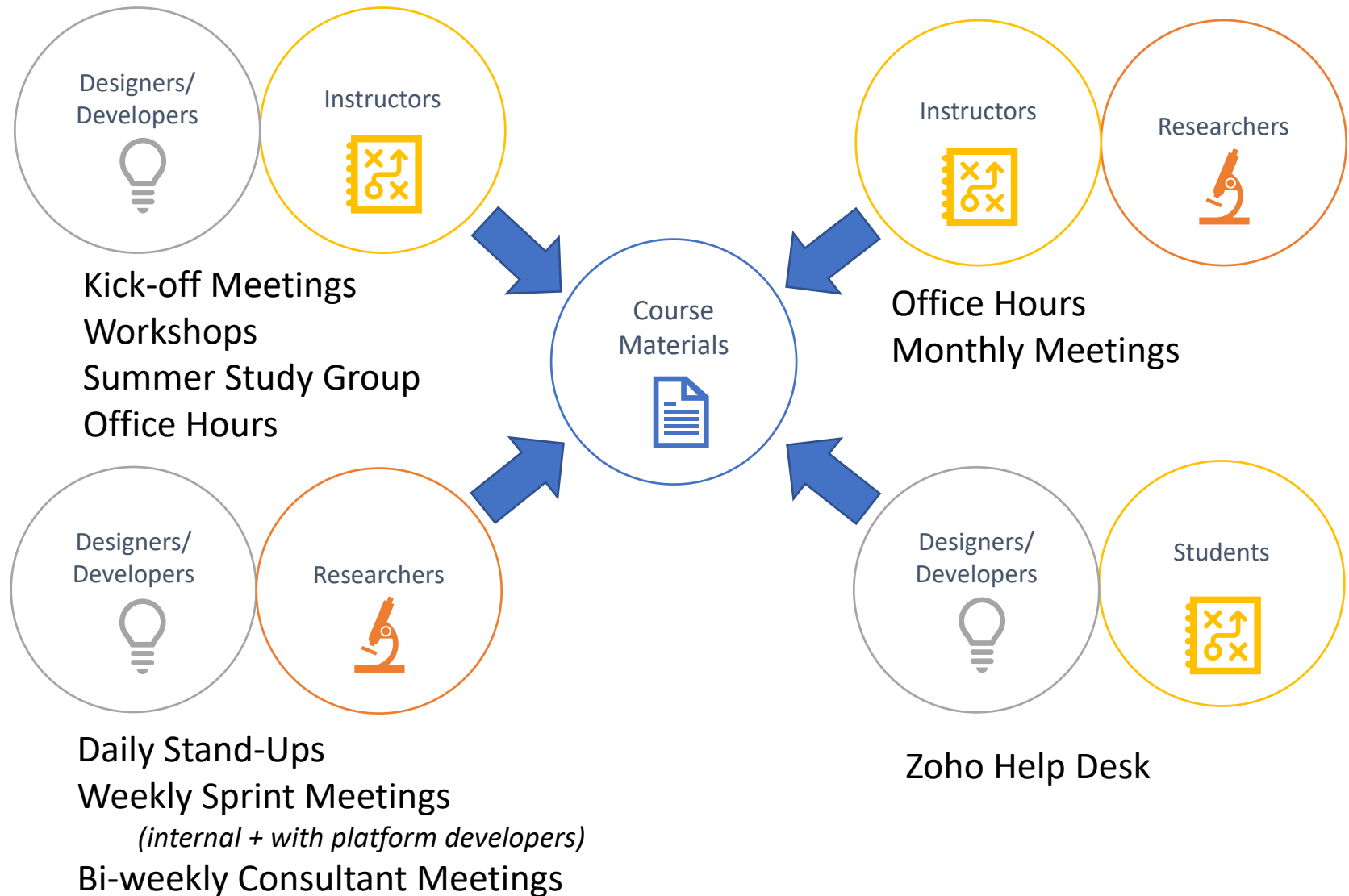
4

THE WHERE

Settings in Which to Do the Work



The Settings (where and when)



Examples of What We've Learned

Wide Range!

1. Errors that require no discussion

Typos

2. Changes managed via discussions in the NICs

Teach null model then single explanatory variable, or the reverse?

3. Alternatives that arise via NIC discussions, to be tested with experiments

Do videos improve student test performance?

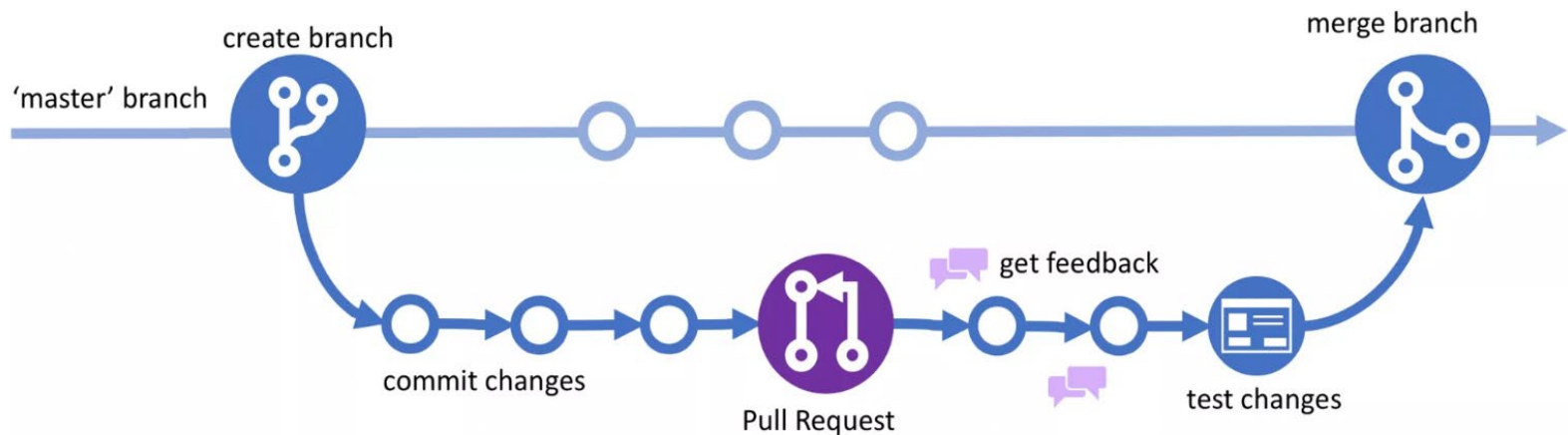
Where We Capture Improvements



Version-control system

Tracks changes in any set of files

Supports distributed, non-linear workflows





5

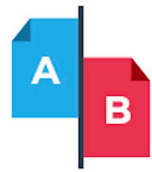
THE HOW

An Attitude of Humility



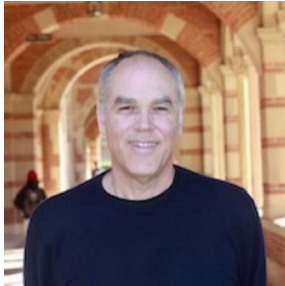
An Attitude of Humility Leads To...

- Readiness – *even eagerness* – to be wrong
- Openness to criticism
- Improvement

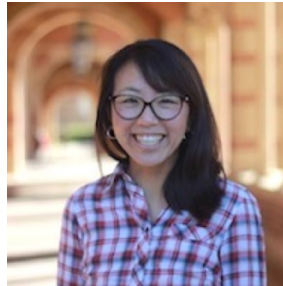


CourseKata

Shout out to our amazing team!



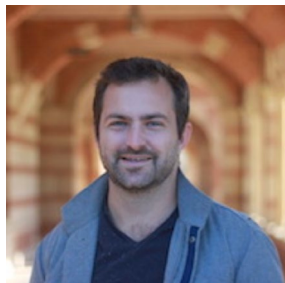
Jim Stigler



Ji Son



Eddie Tchertchian



Adam Blake



Laura Fries



Mary Tucker



Caylor Davis



Icy Zhang



Ben Winjum



Thank You!

